

Effect of few-mode fiber profile on long-haul MDM transmission

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Abstract

The efforts for higher spectral efficiency have increase interests in a mode division multiplexing (MDM) systems. However, sensitivity of MDM to modal crosstalk and fiber nonlinearity (leading to nonlinear phase noise) forms the main penalty. Therefore, few-mode fibers (FMFs) are designed to guide a few modes in MDM transmission. In this paper, a numerical analysis is established to estimate the transmission performance of three different kinds of few mode fibers (FMF) that can be realized in long-haul MDM systems. The fibers, namely step index-FMF (SI-FMF), graded index-FMF (GI-FMF) and transversal index-FMF (TI-FMF), are designed to carry three spatial modes. In order to explore the MDM performance, LP01, LP11a and LP11b modes are modulated with 4QAM format at 10 Gsymbol/s and sent into the fibers. Multiple-input multiple-output digital signal processing is utilized for compensating modal crosstalk. The results reveal that the signal quality that transferred by LP11 mode over GI- or TI-FMFs is substantially improved as compared to LP01 mode over entire transmission distances. However, SI-FMF fiber enables LP01 mode to transport signal with higher quality than LP11a and LP11b mode in long-haul 4QAM MDM transmission.